



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/FI93/00160</p> <p>(22) International Filing Date: 15 April 1993 (15.04.93)</p> <p>(30) Priority data: 921711 15 April 1992 (15.04.92) FI</p> <p>(71)(72) Applicant and Inventor: SAVOLAINEN, Jorma [FI/ FI]; Viljelijantie 4-6 C 86, SF-00410 Helsinki (FI).</p> <p>(74) Agent: PAPULA REIN LAHTELA OY; Box 981, Salom- onkatu 17 B, SF-00101 Helsinki (FI).</p> <p>(81) Designated States: AT, AU, BB, BG, BR, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, US, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p>		<p>Published With international search report.</p>
<p>(54) Title: BICYCLE</p> <div data-bbox="422 1197 1282 1848"> </div> <p>(57) Abstract</p> <p>The invention relates to a bicycle with a frame (1) formed of two elements, i.e. a front frame member (2) and a rear frame member (3), which are interconnected by a pivotal structure (13), so that the front frame member (2) and the rear frame member (3) are foldable from the riding position to meet each other in the transport position of the bicycle.</p>		

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## BICYCLE

The invention relates to the bicycle defined in the introductory section of patent claim 1.

5 In the prior art there is known a bicycle composed of two parts, i.e. a front frame member and a rear frame member, which members are interconnected by a pivotal structure. Thus the front and rear frame members are turnable at the pivotal structure to meet  
10 each other when the bicycle is adjusted to transport position. In the normal riding position the pivotal structure is locked so that the front and rear members of the frame form an essentially stationary, normal bicycle frame. A generally used pivotal structure is a  
15 pivotal hinge, in which case the front frame member is turnable around a hinge pin to meet the rear frame member.

A drawback with the previously known bicycle is that in the riding position, the strain is focused  
20 directly on the axis of hinge, wherefore the hinge structure must be fairly robust. Another drawback is that the pivotal hinge is located outside the frame structure and remains totally unprotected from weather conditions and external mechanical strain.

25 Yet another drawback of the known bicycle is that in the riding position, the front and rear frame members must be secured to each other in order to facilitate transport by pulling the bicycle manually. On the whole, other type of transport than carrying the bicycle  
30 for instance in the boot of a car or in a public transport vehicle is neither practical nor convenient. The pivotal structure is cumbersome, not to mention the fact that hardly any attention has been paid to the design or weight of the frame structure itself, for  
35 instance in order to facilitate transport by pulling by the hand when walking.

The object of the invention is to eliminate

the above mentioned drawbacks. A particular object of the invention is to introduce a new type of city bicycle, which is particularly well suited to riding short distances and is easily adjustable from riding position to transport position, to form an easily transportable package which is as small as possible.

The bicycle of the present invention is characterized by the novel features of the patent claim 1.

The bicycle of the invention comprises a frame composed of two parts, i.e. the front and rear frame members, which are interconnected by a pivotal structure so that the front and rear frame members are turnable from the riding position to meet each other in the transport position. According to the invention, the pivotal structure includes a cylindrical casing protected by a sheath, and a first and second segment member, and the cylindrical casing is arranged in connection with the frame, in an essentially perpendicular position to the lengthwise direction of the frame, and the first segment member is arranged in connection with the front frame member and the second segment member is arranged in connection with the rear frame member; both of the said segments are installed in the cylindrical casing, on opposite sides of the casing, when seen in the direction of the central axis thereof, and turnably with respect to the central axis of the cylindrical casing, so that the first side surfaces of the segment members are arranged to be supported against each other in the riding position, most advantageously above the central axis, and to be released of each other when the front and rear frame members are folded to transport position complete with their segments.

The cylindrical casing protected by the sheath can be provided in connection with either the front or rear frame member, together with either the first or second segment. Thus the cylindrical casing constitutes a cylindrical recess, part of which is covered by the

segment member of the corresponding frame member, and the segment member of the second frame member is adjustable in this cylindrical casing.

In a preferred embodiment of the bicycle, the sheath of the cylindrical casing is formed as a part of a separate frame member, whereto the seat is connected. By means of the separate frame member, for instance the position of the seat can be adjusted to be suitable with respect to the front and rear frame members. Moreover, the cylindrical casing can be formed as a separate space, whereto the front and rear frame members can be fitted at their segment members.

In another embodiment of the bicycle, the first segment member is arranged to protrude from the front frame member, and the second segment member is arranged to protrude from the rear frame member. This structure is particularly advantageous when employing a separate frame member, with the cylindrical casing contained in the sheath connected thereto. Thus the pivotal structure is realized in an advantageous fashion with respect to strength calculations.

In another embodiment of the bicycle, in connection to the front and rear frame members there are provided elevation pieces which are fitted in the cylindrical casing. The purpose of the elevation pieces is to serve as centralizing members so that both the front and rear frame members can be safely and reliably turned around the common turning axis.

In another embodiment of the bicycle, the pivotal structure includes locking means for locking the front and rear frame members to each other, at least in the riding position. Moreover, the locking means are advantageously used for securing the front and rear frame members to each other in the transport position.

In another embodiment of the bicycle, the locking means are arranged to pass through apertures at

the apexes of the first and second segment members of the front and rear frame member respectively, and through the central axis of the cylindrical casing in order to lock the front and rear frame members and the segment members to each other.

In another embodiment of the bicycle, the locking means comprise a stub axle, which at its first end is provided with an end flange or similar stop, and at its second end with a swinging arm including an eccentric member in order to press the front and rear frame members against each other and against the sheath in the locked-up position.

In another embodiment of the bicycle, the sheath of the cylindrical casing comprises annular stop faces, and the segment members are surrounded by annular friction faces of the front and rear frame members, matched with the said stop faces. The purpose of the stop faces and friction faces is to render a maximum amount of contact surface in between the separate members, in order to make them remain in the desired position against each other.

In another embodiment of the bicycle, the annular stop faces of the sheath and the friction faces of the front and rear frame members are conical surfaces. Thus there are not needed high pressures in order to secure the front and rear frame members to each other and to the sheath, particularly in the riding position, and consequently the locking means may be fairly light in structure.

In another embodiment of the bicycle, in between the stop faces and the friction faces, there are arranged friction rings. By means of these friction rings, the maintenance of the bicycle is made easier, and a high friction is created in between the surfaces resting against each other. The friction rings can be manufactured for example of some suitable plastic, such as elastomer, in which case the friction ring functions

in the pivotal structure like a cup spring.

An advantage of the invention is that the bicycle of the invention is easy to use; it is easily folded into transport position and opened back to riding position. The bicycle is easily adjusted to transport position by a couple of manual steps, whereafter it is ready to be carried or pulled from the handlebar. When collapsed, the bicycle also fits in the boot of a car and does not take up a lot of space in storage, for instance.

Another advantage of the invention is that the pivotal structure is simple, reliable and easily realized.

Yet another advantage of the invention is that the elements connected to the pivotal structure are merged in the front and rear frame members, so that there are no protruding or easily breaking parts. The riding, transport by pulling and maintenance of the bicycle is easy.

Yet another advantage of the invention is that the frame and pivotal hinge can be made of for instance composite plastic, in which case the frame becomes light and durable. The manufacturing technique of plastics also allows for providing all necessary functional elements in the frame members and in connection with the sheath of the cylindrical casing. Thus the amount of separate elements in the whole frame construction of the bicycle can be reduced.

In the description below, the invention and other connected advantages are explained in more detail with reference to the appended drawings, wherein figure 1 is a side-view illustration of the bicycle of the invention, seen in riding position; figure 2 is a side-view illustration of the bicycle of figure 1, seen in transport position; figure 3 is an exploded view of the pivotal structure of a bicycle of the invention;

figure 4 is an exploded view of the locking means of the pivotal structure of figure 3;

figure 5 is a cross-sectional illustration of the pivotal structure of figure 3;

5 figure 6 illustrates the configuration of the segment parts of the pivotal structure of figure 3 in riding position; and

figure 7 respectively illustrates the configuration of the segment parts in transport position.

10 The bicycle of the invention is illustrated in the riding position in figure 1. The bicycle comprises a frame 1 formed of two parts, i.e. the front frame member 2 and the rear frame member 3. The front frame member 2 has a front wheel 4 and the rear frame member  
15 3 has a rear wheel 5. The means for moving the bicycle, i.e. the pedals 6, the cog wheels 7, 8 and the chain 9 are arranged in a normal fashion in connection with the rear frame member 3 and the rear wheel 5. The handlebar 10 is connected to the front frame member 2. The seat  
20 11 is connected to the frame member 12 separate from the front and rear frame members, this separate frame member 12 also constituting part of the frame 1.

The front and rear members 2 and 3 of the frame 1 are interconnected by a pivotal structure 13.  
25 Owing to this pivotal structure 13, the front frame member 2, the rear frame member 3 and the separate frame member 12 are turnable to the transport position illustrated in figure 2. In this position, the front 2 and rear 3 frame members are arranged in a roughly  
30 parallel, but slightly crosswise configuration, so that the front wheel 4 and the rear wheel 5 are roughly adjacent. The seat 11 is turned, by means of the separate frame member 12, to a position deviant from the riding position, towards the front wheel 4 and the rear  
35 wheel 5. Now the protruding part of the bicycle is the handlebar 10, from which the collapsed bicycle can be pulled by the hand for instance when walking. Alterna-



tively, the bicycle can be easily fitted for instance in the boot of a car.

A pivotal structure 13 of the bicycle of the invention is illustrated in the exploded figure 3. The pivotal structure comprises a cylindrical casing 15 protected by a sheath 14, a first segment member 16 and a second segment member 17. In this case the sheath 14 of the cylindrical casing 15 is formed as a part of the separate frame member 12, which in turn is connected to the seat 11 as is seen in figure 1. Thus the cylindrical casing 15 is arranged in connection with the separate frame member 12, most advantageously so that the casing 15 and particularly its central axis A-A is essentially perpendicular to the lengthwise axis of the bicycle, i.e. to the longitudinal direction of the frame 1. The lengthwise axis passes via the hubs of the front wheel 4 and the rear wheel 5 when the wheels 4, 5 are in parallel position. Moreover, the cylindrical casing 15 is open at both sides, i.e. it is arranged to pass through the sheath 14.

The first segment member 16 is arranged in connection with the front frame member 2, so that it protrudes from the surface thereof. Respectively the second segment member 17 is arranged in connection with the rear frame member 3, so that it also protrudes from the surface of the frame. In addition to this, the segments 16, 17 protrude in an essentially perpendicular fashion to the lengthwise axis of the bicycle, and at the same time to the longitudinal direction of the frame 1.

The segment members 16, 17 are formed of parts resembling circle sectors with a center angle  $\alpha$ ,  $\beta$  advantageously  $120^\circ$ ; the curved arcs of these sectors constitute the outer surfaces 16c, 17c of the segments, and the radial parts constitute the side surfaces 16a, 16b; 17a, 17b of the segments.

At the segment members 16, 17, the front 2 and

rear 3 frame members are fitted in the cylindrical casing 15, so that the segment members 16, 17 are located on opposite sides of the cylindrical casing 15, when seen from the direction A-A of the central axis of the casing 15. Now the outer surfaces 16c, 17c of the segment members 16, 17 rest against the inner surface 15a of the casing 15, and the apexes are located on the central axis A-A. The front 2 and rear 3 frame members, together with their segment members 16, 17 can now be turned with respect to the central axis A-A of the casing 15.

In connection with the segment members 16, 17 there are advantageously provided elevation pieces 18, 19. These elevation pieces are circular in cross-section and their diameters correspond to the diameter of the cylindrical casing 15. When the segment members 16, 17 are fitted in the cylindrical casing 15, the elevation pieces 18, 19 centralize the segment members 16, 17 to correct locations in the cylindrical casing 15, particularly in relation to the central axis A-A thereof.

The pivotal structure 13 comprises locking means for securing the front 2 and rear 3 frame members and their respective segment members 16, 17 to each other in the riding position of the bicycle, and advantageously in the transport position, too. The locking means may be provided outside the pivotal structure 13 proper, somewhere in between the front and rear frame members 2, 3. By means of them, the front and rear frame members 2, 3, as well as the possible separate frame member 12, are pressed immovably together at the pivotal structure 13, both in the riding and transport positions. When the position of the bicycle is wished to be changed, the pivotal structure 13 is released from the compression of the locking means.

In a preferred embodiment of the invention, the locking means 20 are arranged to pass through the

apertures 33, 34 at the apexes of the first and second segment members 16, 17 and via the central axis A-A of the cylindrical casing 15. As is seen in figure 4, the locking means 20 include a stub axle 21, which is provided with an end flange 22 at its first end and with a swinging arm 23 at its second end. The swinging arm 23 is attached to the stub axle 21 by a pin 24. The swinging arm 23 has an eccentric member 25, such as a suitable protrusion, at a distance from the turning axis formed by the pin 24. The position of the stub axle 21 and the end flange 22 in relation to each other in the direction of the central axis A-A can be adjusted by means of the threaded joint provided therein.

The locking means 20 are operated as follows. When the swinging arm 23 is essentially parallel to the central axis A-A, position B in figure 5, there is looseness in between the elements of the pivotal structure 13, and consequently the elements are movable; thus the position of the frame members 2, 3 and 12 in relation to each other can be changed. The bicycle can be folded from riding position to transport position and back again. When the swinging arm 23 is turned in the direction of the frame, into position C in figure 5, the eccentric member 25 presses, at a point adjacent to the stub axle 21 and the central axis A-A, the rear frame member 3, and further the sheath 14 and the front frame member 2 against the end flange 22, so that these members 2, 3 and 14 are compressed (dotted lines in figure 5) tightly against each other in the locked-up position. By means of the swinging arm 23 and the connected eccentric member 25, there is thus obtained sufficient pressure in a simple and effective fashion.

In connection with the rear frame member 3, there is provided a slot 26 for the swinging arm 23, into which slot the swinging arm 23 is fitted in a position conforming to the shape of the frame 1 after the frame members 2, 3 and 12 are secured to each ot-

her. In the opened-up configuration B (figure 5) the swinging arm 23 can be used as a hand support when moving and particularly lifting the bicycle.

In a preferred embodiment of the invention, the sheath 14 of the cylindrical casing 15 is provided with annular stop faces 27, 28 fitted around the casing. Respectively, around the segment members 16, 17 there are provided annular friction faces 29, 30 of the front and rear frame members, the said friction faces 29, 30 being matched to the said stop faces 27, 28. Advantageously these stop faces 27, 28 and friction faces 29, 30 are conical surfaces as is apparent from figure 5. On the sides of the front and rear frame members 2, 3, these surfaces are advantageously conical to opposite directions, in which case their securing effect is intensified.

When locked in place, the pivotal structure 13 must be absolutely rigid, particularly in the riding position of the bicycle. Then the elements of the pivotal structure 13 must fit smoothly to each other, even when they are slightly worn. The conical shape of the friction faces 29, 30 of the frame members 2, 3, as well as the corresponding shape of the stop faces 27, 28, allows the elements to be locked tightly in place against each other. Thus a strong static friction is achieved in the pivotal structure 13. It is also pointed out that these elements are rubbed against each other, in which case wearing is inevitable. Now in between the said stop faces 27, 28 and the said friction faces 29, 30 there can advantageously be fitted friction rings 31, 32. When necessary, the worn friction rings 31, 32 can be replaced. They can be made of plastic or other suitable material. In addition to this, they serve in between the separate surfaces advantageously as spring-like power transmission means and thus strengthen the rigidity of the pivotal structure.

The operation of the pivotal structure 13 of the bicycle of the invention is illustrated in figures 6 and 7. Let us suppose that the swinging arm 23 in figure 5 is in open position B, in which case the locking means 20 are not in locked-up position and there is looseness in the pivotal structure. The front 2 and rear 3 frame members, as well as the first segment member 16 and the second segment member 17 in the cylindrical casing 15 are now turnable with respect to each other. The front and rear frame members 2, 3 can be turned into the riding position in figure 1, in which case the radial side surfaces 16a, 17a are pressed together and thus supported against each other, advantageously above the central axis A-A, on a level essentially perpendicular to the longitudinal axis of the bicycle and the lengthwise direction of the frame. When the swinging arm 23 of the locking means 20 is turned into position C, i.e. the locked-up position, the eccentric member 25 presses, by intermediation of the stub axle 21 and with the help of the end flange 22, the annular stop faces 27, 28 tightly against the friction faces 29, 30. Now the pivotal structure 13 is stiffened up to form a fixed unity. It is pointed out that in the riding position, the pressure strain is particularly directed against the radial side surfaces 16a, 17a of the segment members 16, 17, and through them to the frame members 2, 3 (cf. figure 6).

The locking means 20 are unfastened when the bicycle is desired to be folded to the transport position in figure 2. The swinging arm 23 is turned from position C to position B in figure 5, whereafter the front and rear frame members 2, 3 can be turned in relation to each other in a fashion illustrated in figure 2. The separate frame member 12, whereto the seat 11 is attached, can also be turned to the desired position. The front and rear frame members 2, 3 can be turned with respect to the axis A-A, in this case 90°,

so that the second radial side surfaces 16b, 17b of the segment members 16, 17 meet, as is illustrated in figure 7. This position corresponds to the bicycle transport position of figure 2. Again, by turning the swinging arm 23 of the locking means 20 from position B to position C, the front and rear frame members 2, 3 can be locked in this position so that they cannot move with respect to each other. At the same time, the separate frame member 12 is locked in a desired bent transport position.

It is pointed out that the separate frame member 12 can be moved fairly freely in between the front and rear frame members 2, 3 while adjusting the position of the bicycle. The trajectory of the separate frame member 12 around the central axis A-A is over 200°.

The invention is not restricted to the above described embodiments, but several modifications are possible within the scope of the inventional idea defined in the appended patent claims.

## PATENT CLAIMS

1. A bicycle, with a frame (1) composed of two elements, the front frame member (2) and the rear frame member (3), which are interconnected by means of a pivotal structure (13) so that the front frame member (2) and the rear frame member (3) can be folded from the riding position to meet in the transport position, characterized in that the pivotal structure (13) comprises a cylindrical casing (15) protected by a sheath (14), and first and second segment members (16, 17), and that the said cylindrical casing (15) is arranged in connection with the frame (1), in an essentially perpendicular position to the longitudinal direction of the frame, and that the first segment member (16) is arranged in connection with the front frame member (2), and the second segment member (17) is arranged in connection with the rear frame member (3), said segment members (16, 17) being installed in the cylindrical casing (15) on opposite sides of the casing, when seen in the direction of the central axis (A-A) thereof, and turnably with respect to the central axis (A-A) of the cylindrical casing (15), so that the first side surfaces (16a, 17a) of the segment members (16, 17) are arranged to be supported against each other in the riding position, advantageously above the central axis (A-A) of the casing (15), and to be detached of each other when the front frame member (2) and the rear frame member (3) are turned, complete with their segments (16, 17) from the riding position to the transport position with respect to the central axis (A-A).

2. A bicycle according to claim 1, characterized in that the sheath (14) of the cylindrical casing (15) is formed as part of the separate frame member (12), whereto the seat (11) is connected.

3. A bicycle according to claim 2, characterized

a c t e r i z e d in that the first segment member (16) is arranged to protrude from the front frame member (2), and the second segment member is arranged to protrude from the rear frame member (3).

5 4. A bicycle according to claim 3, c h a r a c t e r i z e d in that in connection with the segment members (16, 17) there are provided elevation pieces (18, 19) which are fitted in the cylindrical casing (15).

10 5. A bicycle according to claim 1, 2, 3 or 4, c h a r a c t e r i z e d in that that the pivotal structure (13) includes locking means (20) for locking the front and rear frame members (2, 3) and their segment members (16, 17) together, at least in the riding  
15 position of the bicycle.

6. A bicycle according to claim 5, c h a r a c t e r i z e d in that the locking means (20) are arranged to pass through apertures (33, 34) at the apexes of the first and second segment members (16, 17)  
20 and via the central axis (A-A) of the cylindrical casing (15) in order to lock the front and rear frame members (2, 3) and the segment members (16, 17) together.

7. A bicycle according to claim 6, c h a r a c t e r i z e d in that the locking means (20) include a stub axle (21), which at its first end is provided with an end flange (22) or similar stop member, and at its second end with a swinging arm (23), which has an eccentric member (25) in order to press the  
25 front frame member (2) and the rear frame member (3) together and further against the sheath (14) in the locked-up position.

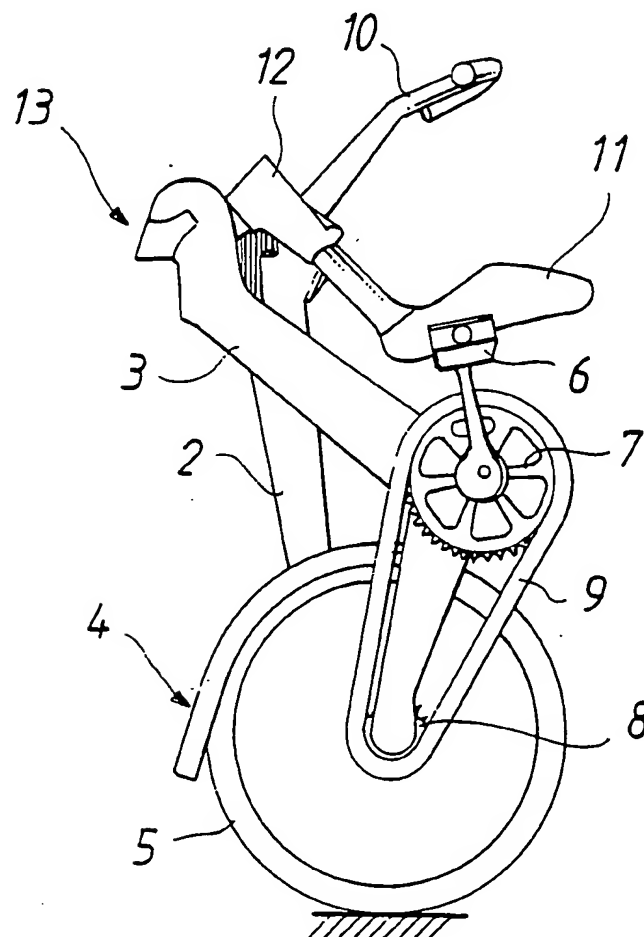
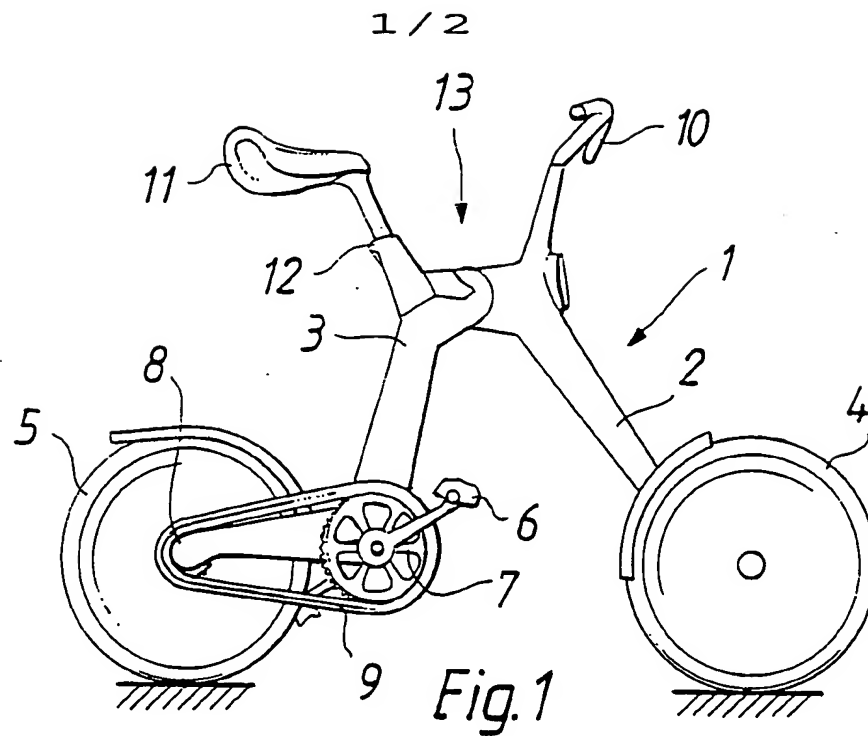
8. A bicycle according to any of the preceding claims, c h a r a c t e r i z e d in that the  
35 sheath (14) of the cylindrical casing (15) is provided with annular stop faces (27, 28) and that around the segment members (16, 17) there are provided annular



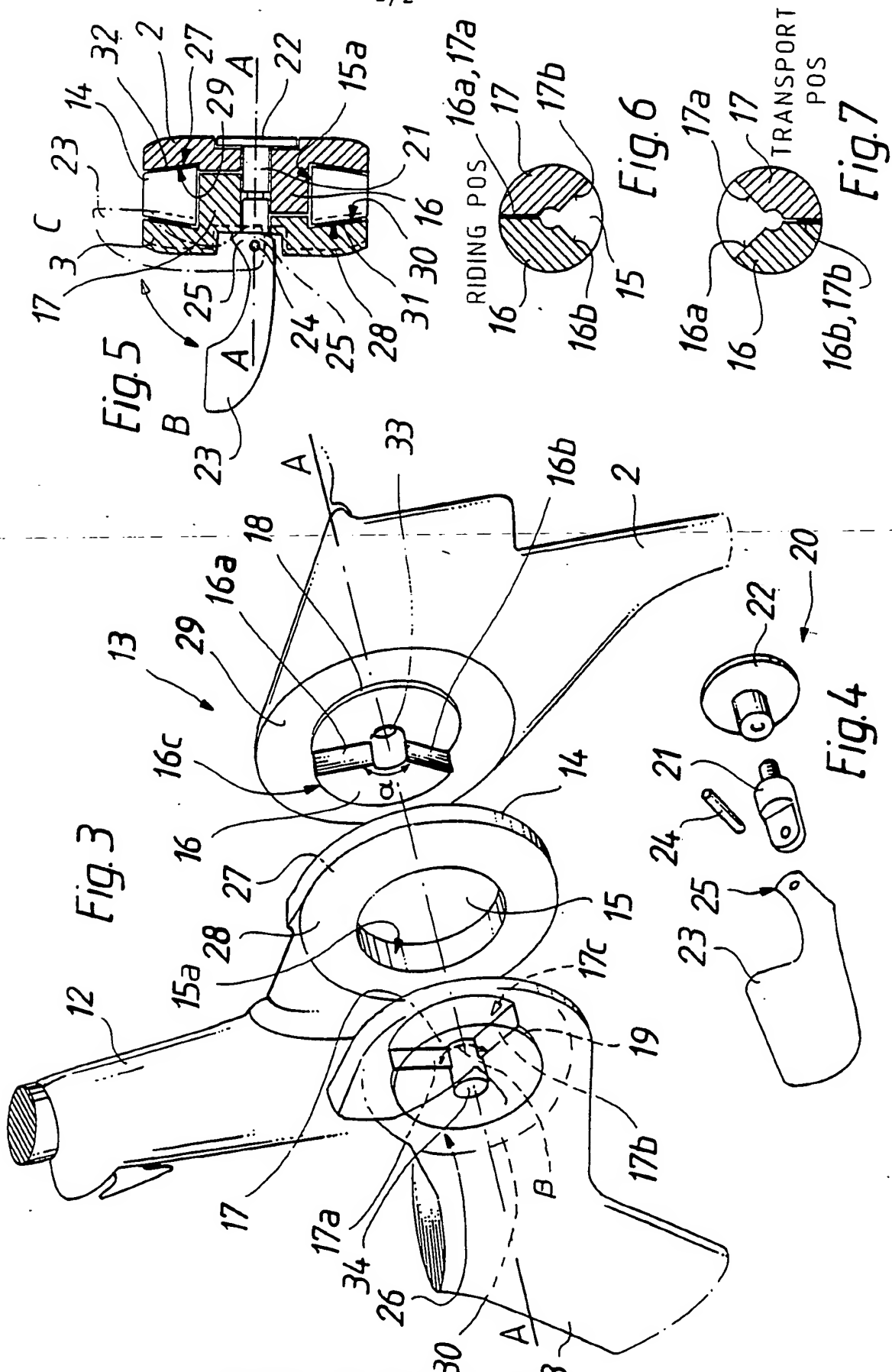
friction faces (29, 30) of the front and rear frame members, matched to the said stop faces.

9. A bicycle according to claim 8, c h a r -  
a c t e r i z e d in that the annular stop faces (27,  
5 28) of the sheath and the friction faces (29, 30) of  
the front and rear frame members are conical surfaces.

10. A bicycle according to claim 8 or 9,  
c h a r a c t e r i z e d in that in between the stop  
faces (27, 28) and the friction faces (29, 30) there  
10 are fitted friction rings (31, 32).



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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 93/00160

## A. CLASSIFICATION OF SUBJECT MATTER

IPC5: B62K 15/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: B62K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO, A1, 9202402 (SINCLAIR RESEARCH LTD.), 20 February 1992 (20.02.92)	1
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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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**Information on patent family members**

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